(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 April 2002 (11.04.2002)

PCT

(10) International Publication Number
WO 02/29159 A1

(51) International Patent Classification[7]: D21G 1/00

(21) International Application Number: PCT/FI01/00827

(22) International Filing Date:
21 September 2001 (21.09.2001)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
20002170 2 October 2000 (02.10.2000) FI

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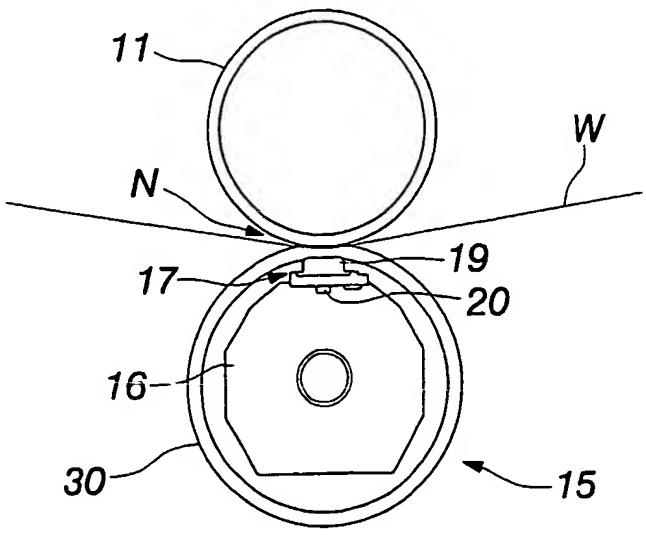
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EC, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND ARRANGEMENT FOR CALENDERING A WEB COMPRISING A LONG-NIP CALENDER



(57) Abstract: The invention relates to a method and calender arrangement for calendering a material web (W), especially a paper or board web, in a long-nip calender, in which the backing roll (11) of the long-nip roll (15) is a heated, chilled-surface roll. The length of the long nip (N) in the direction of travel of the material web (W) is within the range from approximately 10 mm to 500 mm. In the invention, as a long-nip roll (15) is used a roll, the belt mantle (30) of which is made of metal at least as concerns its calendering, longitudinal, central area (31). In the method, a nip pressure within the range from 0.1 MPa to about 50 MPa is directed at the material web (W), and the surface temperature of the rolls (11, 15) before the nip (N) is adjusted to a value from about 60 °C to about 350 °C.

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METHOD AND ARRANGEMENT FOR CALENDERING A WEB COMPRISING A LONG-NIP CALENDER

The present invention relates to a method for calendering a material web and a calender arrangement for implementing the method.

The object of the invention is a method for calendering a material web, especially a paper or board web, in a long-nip calender, in which the backing roll of the long-nip roll is a heated, metal-surfaced roll, in which case the length of the nip in the direction of travel of the material web is within the range from approximately 10 mm to 500 mm. The invention also relates to a calender arrangement for calendering a material web, especially a paper or board web, the said arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll is a heated, metal-surfaced roll, the rolls of which form a long nip between them, the length of which in the direction of travel of the web is within the range from approximately 10 mm to 500 mm.

In improving the quality of calendering, in practice the only possibility has previously been to increase the number of calendering nips, which has resulted in a more complex calender structure and more difficult paper web control and threading. Attempts have been made to solve these problems by using various belt and shoe calenders, by means of which the calendering nip is lengthened, and thus the operation of the nip is enhanced. For example, paper calendered with belt calenders is brought by means of an endless belt into initial contact with a hot calender roll, whereby a steep temperature gradient advantageous to calendering can be achieved. By means of the belt, the effective length of the nip increases due to the initial contact and because it is possible to use much softer polymers as belt

material than in roll coatings without problems arising from deformation due to heat. By means of a nip longer than that in a super- or softcalender, the pressure impulse directed at the paper can be increased without the pressure peak becoming too great and the bulkiness beginning to diminish.

A belt calendering solution has been previously described, for example, in Finnish patent publication no. 95061, in which the calendering nip is formed between a heated, hard-surfaced roll and a metal belt supported by means of a calender roll having a resilient coating. One disadvantage of this solution is that the maximum nip pressure is insufficient for several paper grades requiring a high degree of calendering.

One aim of the present invention is to achieve a solution by means of which calendering can be carried out between two hard surfaces without the disadvantages relating to conventional machine calendering, such as relatively great variations in gloss and a decrease in bulk. These disadvantages are caused by the relatively high nip pressure used in machine calendering, which is typically of the order of approximately 100 MPa.

To achieve the aims of the present invention, the method relating to the invention is characterised in that as a long-nip roll is used a roll, the belt mantle of which is made of metal, at least as concerns its calendering, longitudinal, central area; that in the method, a nip pressure within the range from about 0.1 MPa to about 50 MPa is directed at the material web W, and that the surface temperature of the rolls before the nip N is adjusted to a value from about 60°C to about 350°C. The nip pressure is preferably within the range from about 0.2 MPa to about 15 MPa, and the surface temperature is preferably within the range from about 120°C to about 300°C. Compared with machine calendering, by means of the solution

relating to the invention is achieved, among other things, more uniform gloss, preservation of bulk and good smoothness.

The calender arrangement relating to the invention is in turn characterised in that the belt mantle of the long-nip roll is made of metal, at least as concerns its calendering, longitudinal, central area.

The invention is described in greater detail in the following, with reference to the accompanying drawings, in which

Figure 1 shows a diagrammatic view of the long-nip calender arrangement relating to the invention, as seen from the end, and

Figure 2 shows a diagrammatic perspective view of an embodiment of a belt mantle of a long-nip roll applicable to the calender arrangement relating to the invention.

Figure 3 shows a diagrammatic view of another embodiment of a belt mantle of a long-nip roll applicable to the calender arrangement relating to the invention, as seen from the end.

According to Figure1, the calender arrangement relating to the invention comprises a shoe roll 15, in which on a stationary axle 16, at the nip N, is arranged a loading member 17, which comprises a shoe part 19 extending over the width of the nip (in the longitudinal direction of the roll), and the pistons 20 loading it. Around the shoe 19 runs a belt mantle 30, which is made of metal, at least in its calendering central area, as shown in Figure 2.

In the embodiment shown in Figure 2, the central area of the belt mantle 30 is comprised of a steel belt 31, which extends over the length of the shoe 19, and to it are connected end sections 32 made of resilient material, which may be, for example, polymer, rubber, silicone, etc. The end sections 32 are connected to the steel belt 31 in a flexible manner, for example, by glueing or curing. The connection is made at a point outside the shoe part 19 to avoid directing a fatiguing load on the steel belt.

The steel belt 30 can also be made completely of metal, for example, by providing the end sections of the belt mantle with elastic sealing rings, which are fitted to rotate with the said mantle, as described in Finnish patent no. 66932.

Figure 3 shows a solution in which a thin-walled metal cylinder 41 is fitted over the polymer belt 40 of a shoe roll 15, the cylinder being tightened in place by means of the internal air pressure of the roll. The length of the cylinder 41 is the same as the width of the material web and it is not fixed to the end structures of the shoe roll, whereby loading causing fatigue in metal materials is avoided in the edge area of the shoe.

Between the long-nip roll 15 and its heated, metal-surfaced backing roll 11 is formed a long nip N, through which the material web W is guided, in order to calender it. At the web is directed a nip pressure which is within the range from about 0.1 to about 50 MPa, preferably within the range from about 0.2 to about 15 MPa, which is considerably less than the pressure used in normal machine calendering, which is of the order of 100 MPa. The surface temperature of the rolls before the nip N is adjusted to a value from about 60°C to about 350°C, and preferably to a value from about 120°C to about 300°C, when the surface temperature used in conventional machine calendering is typically within the range from about 60°C to about 120°C.

The length of the nip N in the direction of travel of the material web is preferably within the range from about 10 mm to about 500 mm. The surface roughness R_a of both the steel belt 30 of the long-nip roll 15 and of the outer surface of the backing roll 11 is preferably less than 0.3 μm, whereby the material web W can be subjected to gloss treatment. The calender arrangement relating to the invention can also be used for one-sided or both-sided mat drive by using a sufficiently high R_a value for the steel belt and/or the surface of the backing roll, for example, within the range R_a = about 0.4 to about 2.0 μm.

The solution relating to the invention is applicable to both on-line use and off-line use. It is conceivable to use the calender arrangement relating to the invention, for example, on the press section for drying the material web, for pre-calendering before the coating machine and for final calendering after the coating machine.

When using the apparatus relating to the invention in the dryer section of a paper machine, the paper machine can be shortened by leaving a part of the drying cylinder out.

Claims

1. A method for calendering a material web (W), especially a paper or board web, in a long-nip calender, in which the backing roll (11) of the long-nip roll (15) is a heated roll, in which case the length of the nip (N) in the direction of travel of the material web (W) is within the range from approximately 70 mm to 270 mm, **characterised** in that as a long-nip roll (15) is used a roll, the belt mantle (30) of which is made of metal at least as concerns its calendering, longitudinal, central area (31); that in the method, a nip pressure within the range from about 0.1 MPa to about 50 MPa is directed at the material web (W), and that the temperature of the rolls (11, 15) before the nip (N) is adjusted to a value from about 60°C to about 350°C.

2. A method as claimed in claim 1, **characterised** in that the nip pressure is within the range from about 0.2 MPa to about 15 MPa, and that the surface temperature of the rolls before the nip (N) is within the range from about 120°C to about 300°C.

3. A method as claimed in claim 1 or 2, **characterised** in that in the method are used rolls (11, 15), the surface roughness R_a of the outer surface of the mantle of which is less than 0.3 µm.

4. A method as claimed in any of the above claims, **characterised** in that in the method is used a long-nip roll (15), the belt mantle (30) of which is made completely of metal.

5. A calender arrangement for calendering a material web (W), preferably a paper or board web, the arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll (15) is a heated, metal-surfaced

roll (11), the rolls (11, 15) of which form a long nip (N) between them, the length of the nip in the direction of travel of the material web (W) being within the range from approximately 70 mm to 270 mm, **characterised** in that the belt mantle (30) of the long-nip roll (15) is made of metal at least as concerns its calendering, longitudinal, central area (31).

6. A calender arrangement as claimed in claim 5, **characterised** in that the central area of the belt mantle (30) is comprised of a steel belt (31), on the edges of which are flexibly connected end sections (32) made of a resilient non-metallic material.

7. A calender arrangement as claimed in claim 6, **characterised** in that the end sections (32) are connected to the steel belt (31) by glueing or curing.

8. A calender arrangement as claimed in claim 5, **characterised** in that the belt mantle (30) is made completely of metal.

9. A calender arrangement for calendering a material web (W), preferably a paper or board web, the said arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll (15) is a heated, metal-surfaced roll (11), the rolls (11, 15) of which form a long nip (N) between them, the length of which in the direction of travel of the web (W) is within the range from approximately 10 mm to 500 mm, **characterised** in that the belt mantle of the long-nip roll (15) is comprised of a belt (40) made of a polymer, over which is fitted a thin-walled metal cylinder (41).

10. A calender arrangement as claimed in claim 9, **characterised** in that the metal cylinder (41) is tightened in place by means of the internal air pressure

of the roll or connected by glueing or curing to the polymer belt (40) so as to rotate with it.

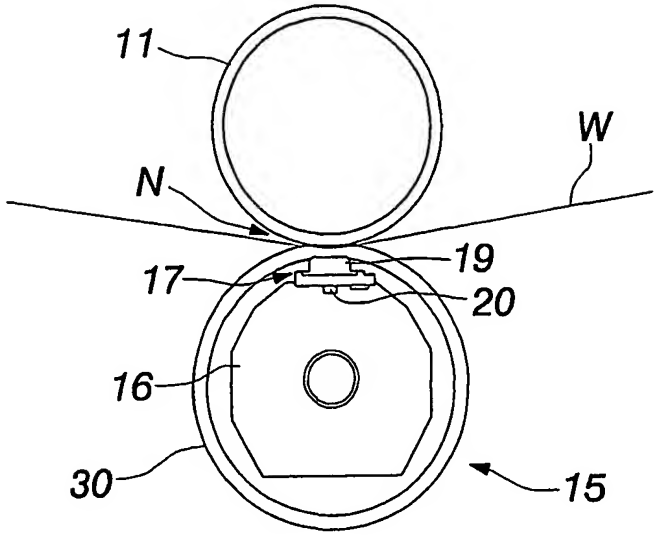

Fig.1

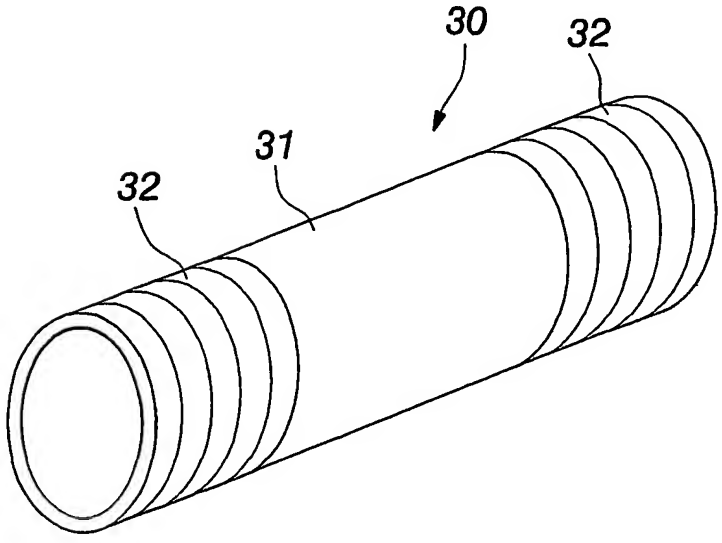

Fig.2

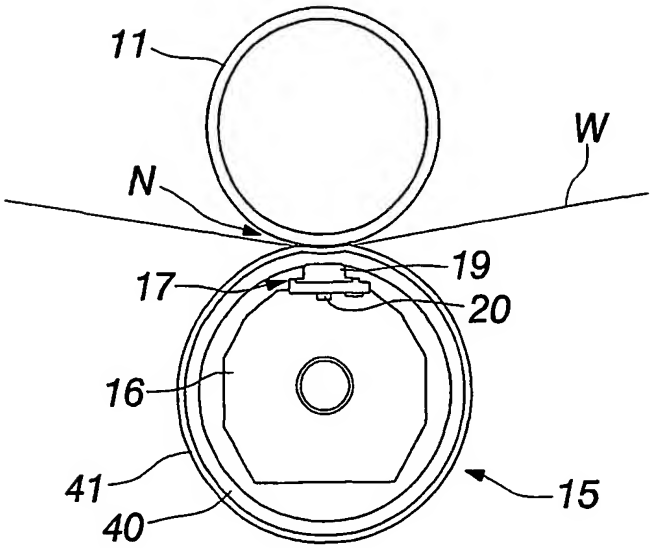

Fig.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00827

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21G 1/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPODOC INTENRAL, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9844196 A1 (VALMET CORPORATION), 8 October 1998 (08.10.98), abstract ---	1-10
A	US 5329847 A (SCHIEL), 19 July 1994 (19.07.94), column 5, line 19 - line 21, figure 1, abstract ---	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 December 2001	15-01-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer NINA BERGSTRÖM/BS Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

06/11/01

International application No.
PCT/FI 01/00827

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9844196 A1	08/10/98	AU 6503798 A	22/10/98
		EP 0973972 A	26/01/00
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